Project 86642

Semi-Passive Chemical Oxidation Schemes for the Long-Term Treatment of Contaminants

Schwartz, Frank

Ohio State University

RESULTS TO DATE: As of the third year of this 3-year project, we have developed numerical models and performed a series of computer simulations to investigate the problems related to the delivery of permanganate to the saturated porous media. Primary results of this study are being prepared for presentation in national conferences and as papers in peer-reviewed publications. In addition, we have assessed the capabilities of various types of chemical mixtures in providing both contaminant destruction and plugging control. Results of this study have been published in peer-review journals.

(1) Slow-release KMnO4

We constructed various forms of slow-release KMnO4 and tested their hydrologic properties through numerical modeling. It was demonstrated through nuemrical modeling approach that the slow-release KMnO4 (35 g of KMnO4) in a single-layered structure could continuously release permanganate in a controlled fashion (~ <100 mg/day) over 900 days. Additional numerical modeling showed that a ?single-barrier?form containing a diffusion barrier could lower the initially high permanganate release rate of over 400 mg/day to ~100 mg/L. Further, duration of the ?single barrier?form could be substantially extended from ~500 days to over 900 days by creating a ?double-layered?form with a diffusion barrier. Proto-type single, single-barrier, and double-barrier forms have been constructed and being tested for their release properties.

(2) Plugging Control

To control pore plugging by MnO2 precipitates, we investigated the mineralogy of MnO2 and use of organic acids in removing the solid precipitates by dissolution. Batch experiments indicated the significant potential in using organic acids like oxalic acid, citric acid, and ethylenediaminetetraacetic acid (EDTA) to remove precipitates formed during the oxidation reaction. Test results showed that the dissolution rate increased with the concentration of citric acid. All of the manganese oxide solid was dissolved and the aqueous manganese concentration reached a maximum concentration.